

## Hive13 Metal Lathe Certification Class

- Lathe safety and setup
- Tool selection for turning operations
- Holding parts using 3-Jaw chuck
- Changing tools and setting spindle speeds
- “Zero” the X and Z axis using the DRO
- Basic facing and turning cuts on aluminum
- Mounting and centering work in the 4-jaw chuck
- Demonstrate understanding of Backlash

### Safety – There is no higher priority than Safety

You, the Lathe operator are responsible for safety - THINK Things Through

**Keep in mind - the Lathe is designed to cut metal, flesh is not a problem!**

THINK - Stay Focused – Don't goof around. Don't let observers play around the lathe  
Chips or splattered coolant can get in your eye.

**ALWAYS** wear safety glasses when operating

Metal chips are razor sharp. Long thin chips are pretty razor wire. Don't touch.

Do Not Wear Gloves when using the lathe. Fingers can get caught (*and removed*)  
Don't Get caught; Long hair, loose sleeves, hoodie strings, or necklaces can pull you in.

### If you have any concerns. Stop the Lathe. Stomp the brake pedal for an instant Stop

Before you do anything, **THINK** about what could happen.

If I don't clamp my part or tool, it could fly out and kill me.

If I take too much off, I could break my bit.

Parts, and bits, fly out when you break something

If I leave the chuck wrench on and start the lathe I could kill someone.

If I don't pay attention the lathe will drive the tool into the chuck.

Damaged part

Damaged chuck

Damaged tool holder

Damaged drivetrain

Unplug! Switch Off! Powerless equipment can't hurt you. It is just a pretty sculpture.

Before plugging in **THINK!** (Is the lathe turned on, be ready in case it is)

After the lathe is plugged in treat it like it could start up.

If you are in control of the switch then you don't need to unplug to work on it.

### What can the Lathe Cut?

The Grizzly Lathe is designed to cut metal; aluminum, brass, iron, steel and plastics. Not wood.  
Wood leaves an abrasive dust which must be completely cleaned from the lathe on completion of the work. Cutting oil and coolant may also stain the wood. Use the wood lathe to cut wood.

## Basic Parts

Grizzly G0776 Lathe Manual [https://wiki.hive13.org/images/e/ed/G0776\\_manual.pdf](https://wiki.hive13.org/images/e/ed/G0776_manual.pdf)

Slides, how they work and what they do – Cutting a taper

Drive gears to change RPM of spindle. How to change

Motor - where it is

Chuck - how it works and how to use it

Drill chuck operation

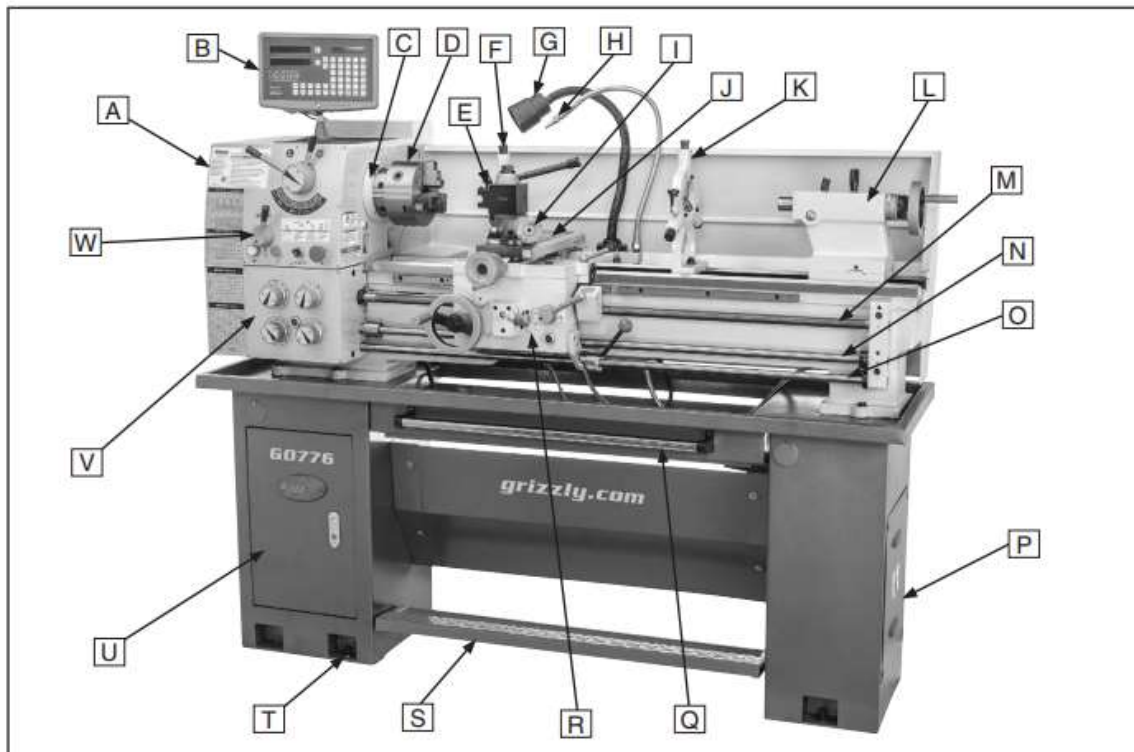
Digital read out (DRO), how it works and how to read it and zero it. - Manual

Cutters - different types, what they do, how they work. (center drill, drill, facing, boring)

Coolant – Why? Why not.

Lube Oil and Cutting fluid – Operation, Checking, Adding.

## Identification



- |   |   |
|---|---|
| <b>A.</b> Headstock                                 | <b>M.</b> Longitudinal Leadscrew  |
| <b>B.</b> DRO Unit                                  | <b>N.</b> Feed Rod  |
| <b>C.</b> D1-4 Camlock MT#5 Spindle                 | <b>O.</b> Control Rod   |
| <b>D.</b> 3-Jaw Chuck 6"                            | <b>P.</b> Coolant Reservoir and Pump Access                             |
| <b>E.</b> Quick-Change Tool Post                    | <b>Q.</b> Chip Tray   |
| <b>F.</b> Follow Rest                               | <b>R.</b> Carriage (see <b>Page 6</b> for details)                      |
| <b>G.</b> Halogen Work Lamp                         | <b>S.</b> Foot Brake  |
| <b>H.</b> Coolant Valve and Nozzle                  | <b>T.</b> Stand Mounting Points   |
| <b>I.</b> Compound Rest                             | <b>U.</b> Storage Cabinet   |
| <b>J.</b> Cross Slide                               | <b>V.</b> Quick-Change Gearbox Controls (see <b>Page 5</b> for details) |
| <b>K.</b> Steady Rest                               | <b>W.</b> Headstock Controls (see <b>Page 5</b> for details)            |
| <b>L.</b> Tailstock (see <b>Page 6</b> for details) |   |

## Tool selection for turning operations

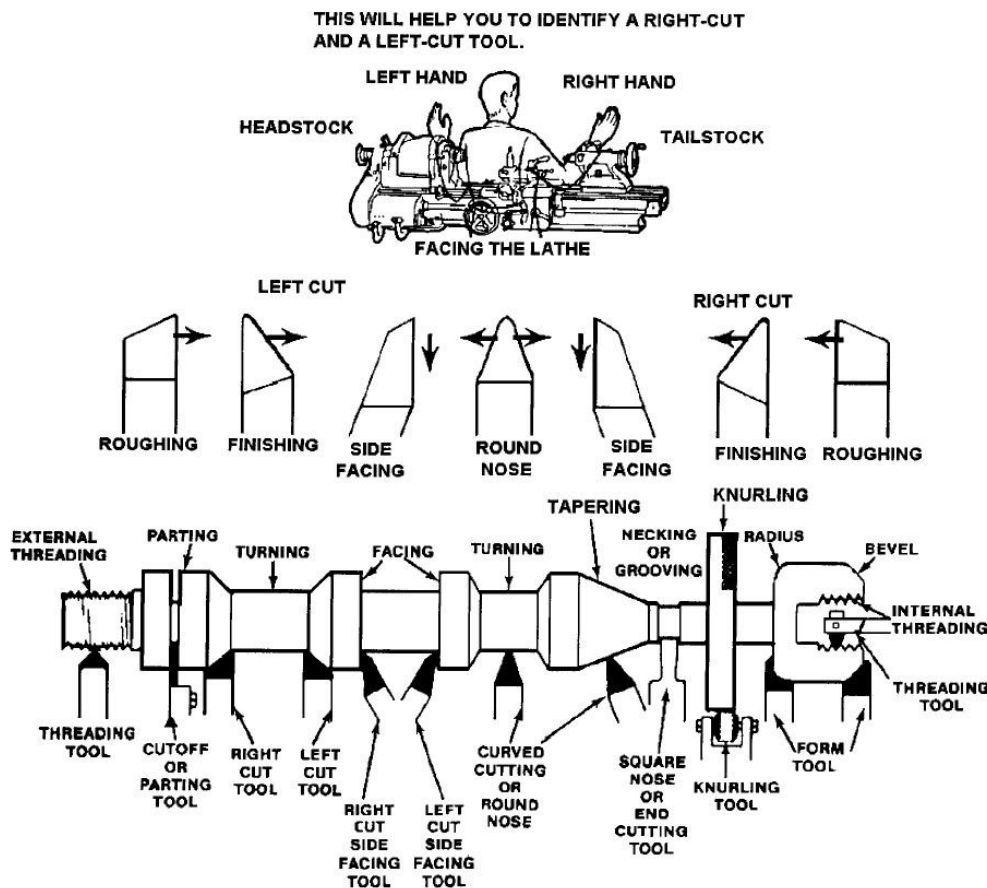
A Lathe cutting tool may be used to both generate or form a work surface.

Generating a work surface moves the tool over the surface to create a shape. – Boring a hole

Forming a surface shapes the workpiece on the shape of the tool. – Thread cutting

Hive13 has a collection of High Speed Steel ( HSS ) and Carbide tooling. HSS tools are shiny. HSS tools are old school, low cost and great grind it yourself tools. HSS will serve most Hive13 requirements very well.

Carbide tools are dull grey or gold in color. Carbide tools are harder and stay sharp longer than HSS.



Further Reference

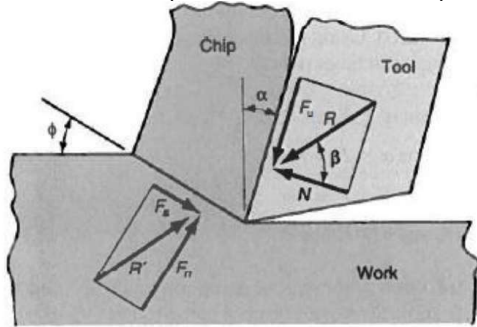
[http://mindworks.shoutwiki.com/wiki/Cutter\\_Types\\_\(Lathe\)](http://mindworks.shoutwiki.com/wiki/Cutter_Types_(Lathe))

[http://sandvik.ecbook.se/SE/en/Training\\_Handbook/](http://sandvik.ecbook.se/SE/en/Training_Handbook/)

<https://smithy.com/machining-handbook/chapter-3/page/19>

## Speeds and Feeds ( and Depth of Cut )

The lathe cutter produces shear at the chip interface.



The rate of metal removal from the workpiece is determined by Speed of tool against the surface, the Feed or forward motion of the tool along the surface. <https://www.youtube.com/watch?v=dVGrNfZBsf0>

**The proper cutting speed for a given job is a determined by multiple factors: 1) Hardness and machinability of the workpiece. 2) Tool material. 3) Feed rate. 4) Depth of Cut. 5) Expected tool life of cutter. 6) Time.**

**Though charts and calculators exist for cutting Speeds and Feeds, the machinist is ultimately responsible for the decision. Speed charts assume smooth cuts of uniform workpiece material. This means no discontinuous cuts or inclusions in the material.**

**The Cutting Speed of a tool bit is defined as the number of feet of workpiece surface, measured at the circumference, that passes the tool bit in one minute. FPM = Feet per Minute. Do not confuse Cutting speed = FPM with Spindle speed of the lathe = RPM.**

The exact RPM are not always needed. A close approximation will work. ( Use  $\pi = 3$  ). Spindle revolutions per minute (RPM) are determined by using the formula:

$$\text{RPM} = \frac{\text{Speed}}{\text{Circumference}} = \frac{\text{Speed}}{\text{Diameter} \times \pi} = \frac{\text{SFM} \times (12 \text{ inc /Foot})}{\text{Diameter} \times 3} = \frac{\text{SFM} \times 4}{\text{Diameter}}$$

**Do Note: Regardless of the calculated speeds and feeds, the operator should proceed with caution.**

**Start slower than the recommendation. Assure the cut is producing the desired results. Step up speed in increments to the recommended limit. Speed and Feed calculations are intended as time savers to achieve fast cuts within expected tool life. Slower speeds and feeds rarely if ever produce undesirable results. Consider that a broken tool or damaged workpiece more than double your work time.**

You can use the Hive13 copy of G-Wizard to calculate speeds and feeds. The CAD Station or CNC router have access to G-Wizard. Regard these as maximum recommended speeds. NOT your starting speed.

Further Reference

[https://en.wikipedia.org/wiki/Speeds\\_and\\_feeds](https://en.wikipedia.org/wiki/Speeds_and_feeds)

<https://www.custompartnet.com/calculator/turning-speed-and-feed>

<https://littlemachineshop.com/reference/cuttingspeeds.php>

## Basic Machining

Materials (start with soft stuff)

Measuring, Dial Calipers, Digital Indicator, Hole gauges

Marking. Machinist Dye, Scribes. Centerpunch

Mounting the workpiece

Choosing and mounting the correct tool (cutter selection)

Speeds and feeds

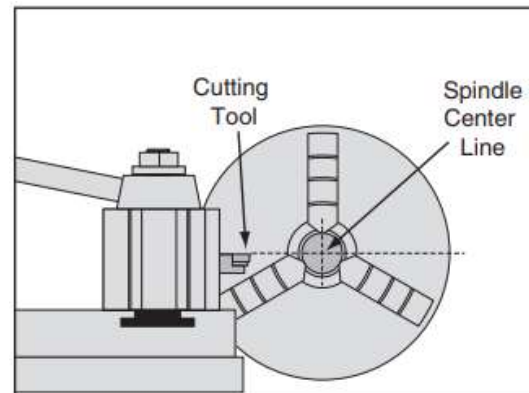
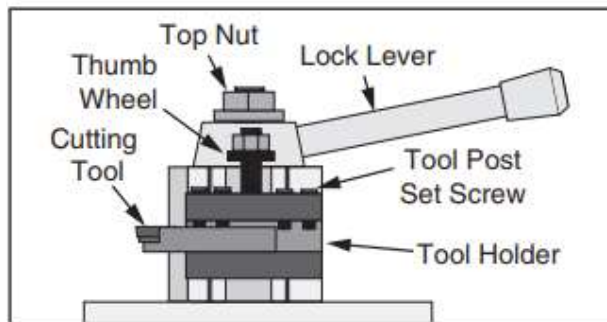
Use the DRO to establish zero

Drilling a hole (center drill first, check the drill diameter with caliper)

Cutting an edge (find zero, just take a little off, chips, sound)

Cleaning up – Do not blow chips - Use the vacuum and chip shovel

## Quick Change Tool Post



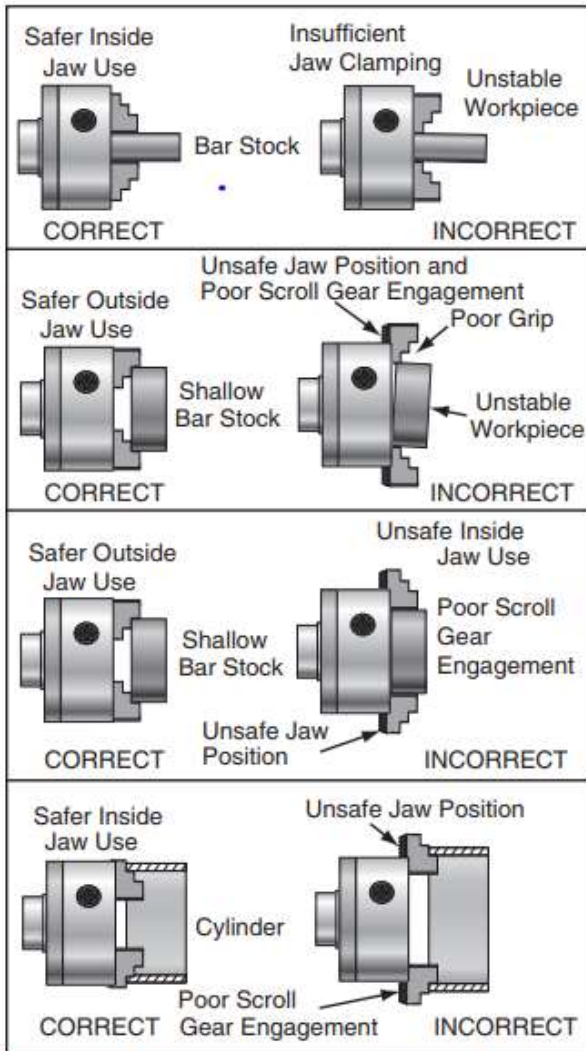
## Pinched or Tangent Ruler Technique

Chuck a piece of round stock. Carefully move the cross slide to gently pinch a thin steel ruler between the tool and workpiece. Back off the slide and adjust the tool height until the ruler is vertical. Note: This works for internal boring bars if you pinch against the back side of the part.





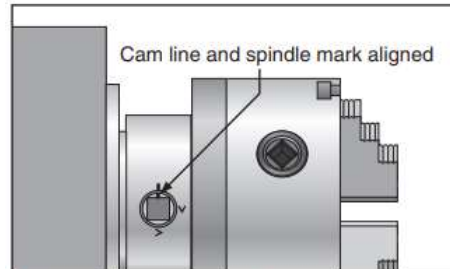
## Mounting and centering work in the Chuck



**Figure 31.** Jaw selection and workpiece holding.

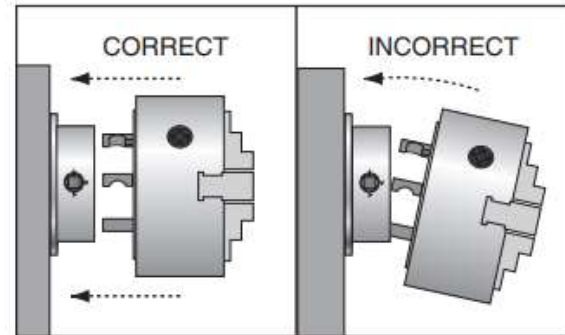
## Removing the 3 or 4 jaw chuck

- Protect the lathe ways
- Disconnect power
- Loosen cam locks with chuck key

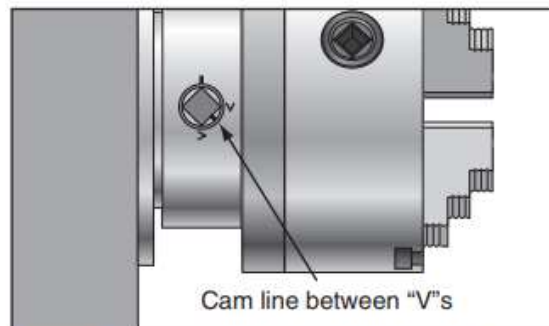


**Figure 30.** Camlock is fully loosened when the cam line is aligned with the spindle mark.

- **Don't drop the chuck**
- **Tap chuck side with soft hammer**
- **Slide cam locks out of the chuck**



- **Clean and lubricate the mating faces of the spindle and chuck**
- **Check with fingers to assure no chips or bumps on mating faces**
- **Mount the chuck**
- **Tighten cam locks in rotation**



**Figure 27.** Cam line positioned between the "V" marks after the camlocks are fully tightened.

## Power Feed – Summarized from Page 50 of the Grizzly manual.

Both the carriage and cross slide have power feed capability when the carriage is engaged with the feed rod. The rate that these components move per revolution of the feed rod is controlled by the quick-change gearbox dial positions and the end gear configuration.

The feed per revolution and the spindle speed must be considered together—this is the feed rate. The sources you use to determine the optimum spindle speed for an operation will also provide the optimal feed to use with that spindle speed. Remember, this is the upper recommended speed limit.

The carriage can also be driven by the leadscrew for threading. Threading is not shown in this section.

### Power Feed Controls Checklist

#### α. First things first Check End Gear Position

Note: Before using power feed, you may have to change the end gears position, depending on how they are set up. This is the configuration you need. For power feed. Refer to Manual section for End Gears on Page 52 Figure 72 for detailed instructions. Position the shaft keyway up when removing the “Z” gear. Don’t drop the shaft key.

Use Figures 66–67 and the following descriptions to understand the power feed controls.

- A. Feed Direction Lever
- B. Feed Rate Chart – Note: Only the dial settings shown on the chart are valid.
- C. Quick-Change Gearbox Dials
- D. Feed Selection Lever

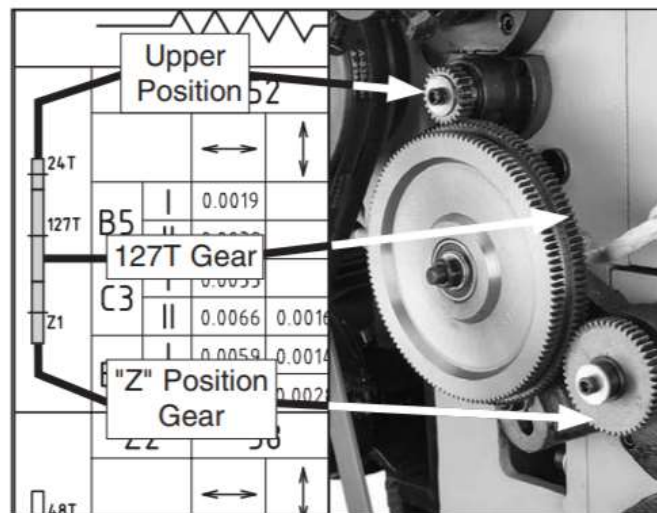


Figure 72. Power feed chart change gears.

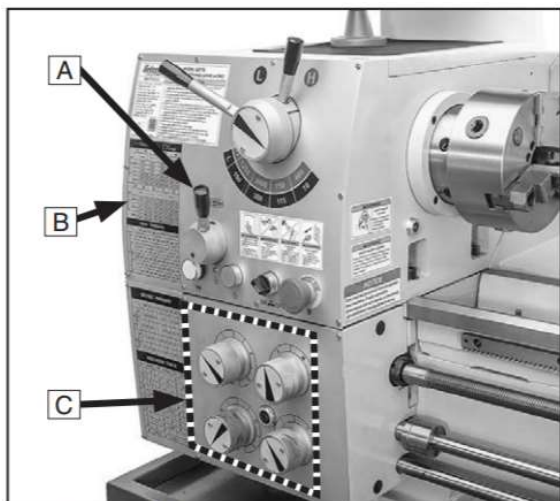


Figure 66. Power feed controls on the headstock.

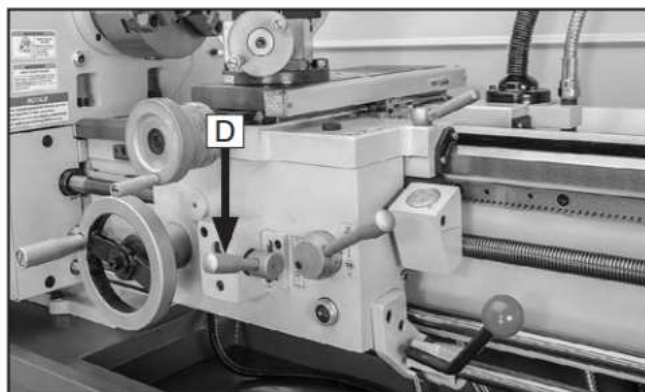


Figure 67. Apron power feed controls.

## Power Feed Details Checklist

**Note: Many of the handle positions are counter intuitive – Follow the images and instructions along with these tips to assure success.**

**A. Feed Direction Lever**

Selects the direction of power feed. Check the detail image on the handle. Set it and make an air cut to verify direction of feed.

**B. Feed Rate Chart**

Note: Only the setting combinations on the gear position and dial settings charts are valid.

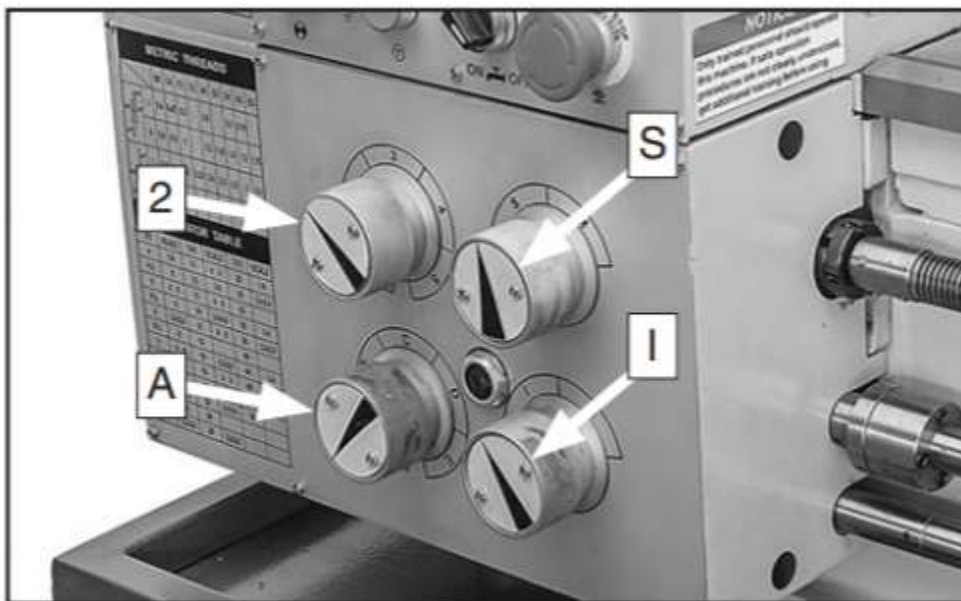
**C. Quick-Change Gearbox Dials**

Position these as indicated on the chart to choose different feed rates. It may be necessary to disengage the spindle drive gears and manually gently move the chuck while setting dial position to engage gears. Do not jog the lathe to align gears.

**D. Feed Selection Lever – Selects power feed to carriage or cross slide**

When the lever is up the carriage is selected. The label on the lever indicates feed associated with the handle position. When down the cross feed is selected. It is necessary to jog the lever right before moving down or left before moving up. It may be necessary to move the handwheel of the component you are trying to engage so that the gears mesh.

**E. The last bit of secret sauce – Set the S/M Dial to S for power feed.**





## **Centering the workpiece in a 4-Jaw Chuck**

### **Best Practice Tricks for Centering Work in the 4-Jaw chuck**

- Everything is easier if you use two chuck keys at the same time.

### **Round Stock centered with Dial Indicator**

<https://littlemachineshop.com/images/gallery/PDF/Centering4-JawChuck.pdf>

### **Square Stock Centered with Shims**

[Joe Pieczynski https://www.youtube.com/watch?v=WCEi5GIEZ5g](https://www.youtube.com/watch?v=WCEi5GIEZ5g)

### **Large Rectangle Centered with Wiggly Bar**

- Find a slim bar of 12 to 24 inch length  $\frac{1}{4}$  inch in diameter or slightly smaller.
- Chuck the bar in the 3-jaw chuck and machine a well centered surface on at least 2 inches of the length. Machine a finely centered point on the machine end of the bar.
- Mount the bar in the tail stock drill chuck with point towards the headstock
- Center punch a center in the workpiece
- Mount the workpiece using eyeball
- Bring the wiggly bar point into contact with the center punch using the tailstock feed
- The wiggly bar will follow the center point.
- Use the dial indicator to center the wiggly bar using the round stock technique, thus centering the workpiece